INTRODUCTION

The eye is impervious to nearly all external agents. Microorganisms accumulation is prevented by continuous tear flow and blink reflex, which wash out the eye surface substances. Tears contain lactoferrin, lysozyme, defensins, and secretory immunoglobulins, reducing ocular surface bacterial colonization. Staphylococcus aureus is the common pathogen in ocular infections such as keratitis, conjunctivitis, lacrimal apparatus, and lid infections. Methicillin-resistant Staphylococcus aureus (MRSA) is a special strain of S. aureus resistant to β-lactams antibiotics. MRSA was first isolated in 1961 in the UK and is now widespread all over the world, particularly in the health-care setting. It causes a high mortality rate across the globe due to the rapid progression of the disease and multidrug resistance. MRSA isolates are commonly multidrug-resistant and resistant to various classes of antibiotics such as erythromycin, fluoroquinolones, tetracycline, and aminoglycosides. There have been various reports from different parts of the world like the USA and India showing an increase in the prevalence of ocular MRSA infections in current years, while other studies demonstrate a reliably stable prevalence in Taiwan. We described the prevalence of ocular infections caused by MRSA and their antibiotic susceptibility pattern recovered from patients with ocular infection in a tertiary care center in North India.
Aims and objectives
The study aimed to determine the prevalence and antimicrobial susceptibility pattern of MRSA in ocular infections.

MATERIALS AND METHODS
The patients were recruited from the outpatient and inpatient departments from July 2018 to February 2021. The study was approved by the Institutional Ethics Committee. All the specimens collected from clinically diagnosed patients were transported to the laboratory for further processing. Identification of organisms was done by conventional methods. Antimicrobial susceptibility was done as recommended by the Clinical and Laboratory Standards Institute using the Kirby-Bauer disc diffusion method. Cefoxitin disk diffusion methods were used for the detection of MRSA.

Polymerase chain reaction (PCR) for mecA gene
PCR amplification of conserved regions of mecA genes in resistant isolates were determined with the primers as described by McClure et al. The Mec A gene was amplified in a total volume of 25 μl reaction mixture that contained 2.5μl DNA templates, 0.24 μM for the primers (mecA 5’GTAGAAATGACTGAACGTCCGATAA-3’ and mecA2 5’CCAATTCCACATTGTTTCGGTCTAA-3’). The PCR was performed in Bio-Rad thermal cycler with cycling conditions consisted of an initial denaturation step at 94°C for 10 min, followed by 25 cycles of final denaturation at 94°C for 45 s, annealing at 50°C for 45 s, and extension for 72°C for 75 s, and the process was completed with the final extension step at 72°C for 5 min. Analysis of amplified PCR product was done by gel electrophoresis.

RESULTS
A total of 76 S. aureus were found in 350 patients with clinically suspected different ocular infections. Among all S. aureus, 41 (53.94%) were MRSA.

MRSA isolates in various ocular diseases
Seventy-six isolates of S. aureus were obtained from various ocular infections. Out of these, 41 (53.94%) isolates were methicillin-resistant, and the remaining 35 (46.05%) were methicillin-susceptible. The maximum number of MRSA were isolated from lacrimal apparatus infections 10 (24.4%), followed by lid infection 7 (17%) and keratitis 6 (14.6%) (Table 1).

Detection of mecA gene
All of the 41 MRSA isolate were positive for mecA by PCR. 310 bp PCR product was obtained for mecA gene (Figure 1).

Antibiotic susceptibility pattern of MRSA isolates
MRSA isolates from the various ocular infections were tested for antimicrobial susceptibility. All MRSA isolates were susceptible to vancomycin, and significant isolates were also susceptible to chloramphenicol, tetracycline, and amikacin. Ciprofloxacin had very low rates of susceptibility, which are commonly used in conjunctivitis (Table 2).

Table 1: MRSA isolates in various ocular diseases

<table>
<thead>
<tr>
<th>Ocular Disease</th>
<th>MRSA isolates (%)</th>
</tr>
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<tbody>
<tr>
<td>Dacryocystitis</td>
<td>10 (24.4%)</td>
</tr>
<tr>
<td>External hordeolum</td>
<td>07 (17.1%)</td>
</tr>
<tr>
<td>Corneal ulcer</td>
<td>06 (14.6%)</td>
</tr>
<tr>
<td>Conjunctivitis</td>
<td>05 (12.2%)</td>
</tr>
<tr>
<td>Orbital cellulitis</td>
<td>04 (9.8%)</td>
</tr>
<tr>
<td>Preseptal cellulitis</td>
<td>03 (7.3%)</td>
</tr>
<tr>
<td>Endophthalmitis</td>
<td>03 (7.3%)</td>
</tr>
<tr>
<td>Panophthalmitis</td>
<td>02 (4.9%)</td>
</tr>
<tr>
<td>Post-surgical infection</td>
<td>01 (2.4%)</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
</tr>
</tbody>
</table>

Table 2: Sensitivity pattern of commonly used antibiotics in ocular infections

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>MRSA (n=41)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
<td>41</td>
<td>100.0</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>40</td>
<td>97.6</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>36</td>
<td>87.8</td>
</tr>
<tr>
<td>Amikacin</td>
<td>35</td>
<td>85.4</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>30</td>
<td>73.2</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>28</td>
<td>68.3</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>20</td>
<td>48.8</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>18</td>
<td>43.9</td>
</tr>
<tr>
<td>Ofloxacin</td>
<td>13</td>
<td>31.7</td>
</tr>
<tr>
<td>Cotrimoxazole</td>
<td>13</td>
<td>31.7</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>10</td>
<td>24.4</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>07</td>
<td>17.1</td>
</tr>
</tbody>
</table>

Figure 1: Agarose gel electrophoresis of MRSA isolates (PCR product of 310 bp indicating mecA gene), Lane M 100 bp DNA ladder, NC: Negative control
DISCUSSION

MRSA is a significant burden in various health-care settings. Our study shows that 53.9% of ocular S. aureus infections were MRSA. Different studies have depicted variations in MRSA rates in ocular specimens in different countries. About 34.9% prevalence rate of MRSA was reported in the USA, 25.4% MRSA was reported in the pediatric age group in China, and 50% MRSA in Italy.14-16 Duration of study, types of samples, site of the specimen, and size of sample may be contributory factors in variations of prevalence at different places.

In this study, the most common presentation of ocular MRSA infections was Dacryocystitis (24.4%), followed by lid disorder (17.1%) and a corneal ulcer (14.6%), which is consistent with the previous study done in south India, but Freidlin et al., reported conjunctivitis as a most common manifestation of ophthalmic MRSA in the USA.22 This difference occurs, maybe due to different geographical locations of study.

In terms of antibiotic susceptibility, all MRSA isolates were sensitive to vancomycin.

In our study, different FQs have different degrees of susceptibility. It is also reported by Nithya et al., and Klos et al.17,18 In our study, among fluoroquinolones moxifloxacin showed the highest efficacy (73.2%). The lowest susceptibility is found in ciprofloxacin (17.1%) and ofloxacin (31.7%). These antibiotics are frequently used in ocular infections.

Chloramphenicol showed good susceptibility (97.6%). Broad-spectrum antibiotics like fluoroquinolones have been used abundantly in recent years and replaced chloramphenicol usage, this could be a possible reason for the good susceptibility shown by MRSA against chloramphenicol. Croghan and Lockington, Harford et al., also showed excellent susceptibility of chloramphenicol against ocular MRSA isolates.19,20

Amikacin (85.4%) has a remarkable susceptibility rate compared to Gentamicin (43.9%) among aminoglycosides. Gentamicin is more commonly used as compared to amikacin, this could be a possible reason for the marked difference in the susceptibility of these two antibiotics. Cotrimoxazole (31.1%) and Azithromycin (24.4%) showed disappointing susceptibility for MRSA. This is consistent with the study by Harford et al, who reported 33.9% susceptibility to azithromycin for MRSA from ocular isolates20

Limitations of the study

Due to limited period study and COVID 19 pandemic the sample size was limited.

CONCLUSION

Treatment of MRSA infections is challenging for clinicians. To prevent MRSA infections proper screening & treatment of MRSA carriers should be followed in an institute. Infection control practices should be followed & monitored and regular microbiological surveillance of associated ocular infections & antibiotic policy should be allowed.

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REFERENCES

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Authors Contribution:
AR- Concept and design the study, prepared first draft of manuscript; SWK- Interpreted the results; reviewed the literature and manuscript preparation; SMZ- Concept, coordination, and interpretation, preparation of manuscript and revision of the manuscript; HMK- Concept and revision of the manuscript; and MS- Drafting, literature review, and final version

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